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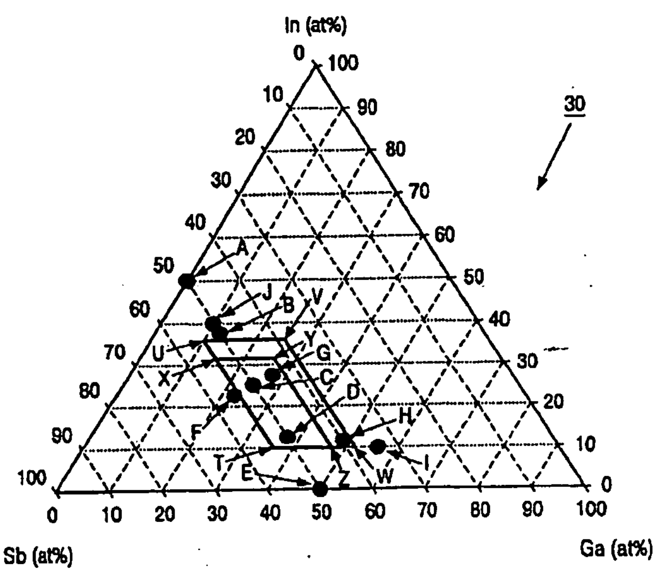
(54) Title: REWRITABLE OPTICAL DATA STORAGE MEDIUM AND USE OF SUCH A MEDIUM



(57) Abstract: A description is given of a rewritable optical data storage medium having a phase-change recording layer on the basis of an alloy of Ga-In-Sb, which composition is situated within the pentagonal area TUVW in a triangular ternary composition diagram. These alloys show an amorphous phase stability of 10 year or more at 30°C. Such a medium is suitable for high speed recording, e.g. at least 30 Mbits/sec, such as DVD+RW, DVD-RW, DVD-RAM, high speed CD-RW, DVR-red and DVR-blue.

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The invention will be elucidated in greater detail by means of exemplary embodiments and with reference to the accompanying drawings, in which

Fig. 1 shows the triangular ternary composition diagram Ga-In-Sb in atom %, in which a two quadrangular areas TUVW and TXYZ as well as points A to J are indicated,

Fig. 2 shows a schematic cross-sectional view of an optical data storage medium in accordance with the invention,

Fig. 3 shows another schematic cross-sectional view of an optical data storage medium in accordance with the invention, and

Fig. 4 shows a graphical representation of the data stability or crystallization time (t_c) of the amorphous phase marks of points A, B, C, G, H, I and J as indicated in Fig.1 as a function of temperature (T in °C).

Examples C, D, G, and H (according to the invention).

In Fig. 2 the rewritable optical data storage medium for high-speed recording by means of a laser-light beam 10 has a substrate 1 and a stack 2 of layers provided thereon. The stack 2 has a first dielectric layer 3 made of $(ZnS)_{80}(SiO_2)_{20}$ having a thickness of 120 nm , a second dielectric layer 5 made of $(ZnS)_{80}(SiO_2)_{20}$ having a thickness of 20 nm and a recording layer 4 of a phase-change material having an alloy comprising Ga, In and Sb. The recording layer 4, having a thickness of 25 nm, is interposed between the first dielectric layer 3 and the second dielectric layer 5. The ratio of Ga, In and Sb in the alloy is represented by points C, D, G and H in the ternary composition diagram of Fig. 1. The exact compositions are indicated in Table 1.

A metal reflective layer 6 of Al, having a thickness of 100 nm, is present adjacent the second dielectric layer 5 at a side remote from the first dielectric layer 3.

A protective layer 7, made e.g. of a laser-light transparent UV curable resin having a thickness of 100 μm is present adjacent the first dielectric layer 3. Spincoating and subsequent UV curing may provide layer 7.

Sputtering provides the layers 3, 4, 5, and 6. The initial crystalline state of the recording layer 4 is obtained by heating the as-deposited amorphous recording layer 4 in a recorder by means of a continuous laser-light beam to above its crystallization temperature.

Table 1 summarizes the results of examples according to the invention, wherein the composition of the Ga-In-Sb alloy has been varied.

Table 1 Example	Ga (at.%)	In (at.%)	Sb (at.%)	CET (ns)	Extrapolated data stability (t_c) at 30°C (years)
C	25	25	50	25	> 1000
D	37.5	12.5	50	11	>> 1000
G	27.5	27.5	45	8	65
H	48	12	40	7	26

All examples C, D, G, and H have an R_a and R_c at λ=670 nm of 16 % and 6 % respectively. The examples C, D, G, and H are situated within the quadrangular area in the ternary composition diagram Ga-In-Sb in Fig. 1. The area has the following vertices T, U, V and W:

$Ga_{36}In_{10}Sb_{54}$ (T)
$Ga_{10}In_{36}Sb_{54}$ (U)
$Ga_{26}In_{36}Sb_{38}$ (V)
$Ga_{52}In_{10}Sb_{38}$ (W).

When in example D the material of the first dielectric layer 3, which is present adjacent the recording layer 4, is replaced by the compound $SiH_{0.1}$, its thickness is decreased to 65 nm and the recording layer thickness is increased to 31 nm, the amorphous reflection R_a increases to 21 %. This has the additional advantage that the optical contrast is higher. Furthermore the CET is shortened from 11 to 7 ns because of the larger thickness of the recording layer 4. In this case the amorphous reflection is larger than the crystalline reflection. This is generally referred to as low to high modulation.

It is also possible to obtain high to low modulation, in which case written amorphous marks have a lower reflection than their crystalline surroundings. A stack 2 having a 30 nm (or 117 nm) thick first dielectric layer 3 of $SiH_{0.1}$, a 31 nm thick recording layer 4 of composition D, a 20 nm thick second dielectric layer 5 made of $(ZnS)_{80}(SiO_2)_{20}$ and a 100 nm thick metal reflection layer 6 made of Ag has an R_a of 6 % and an R_c of 21 %, which is exactly the inverse contrast compared to the stack described in the previous paragraph.

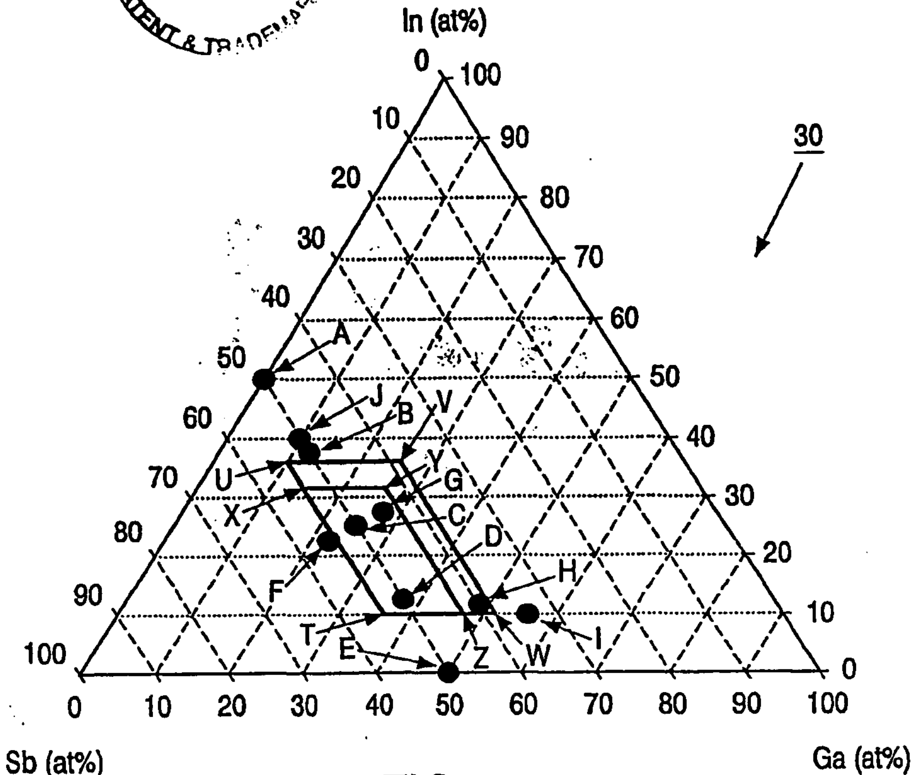
In (at%)
0
100
10
90
20
80
30
70
40
60
50
50
60
40
70
30
80
20
90
10
100
0
0
10
20
30
40
50
60
70
80
90
100
Sb (at%)
Ga (at%)
30
A
J
B
V
Y
U
G
X
C
D
F
H
T
E
Z
W
I

FIG. 1

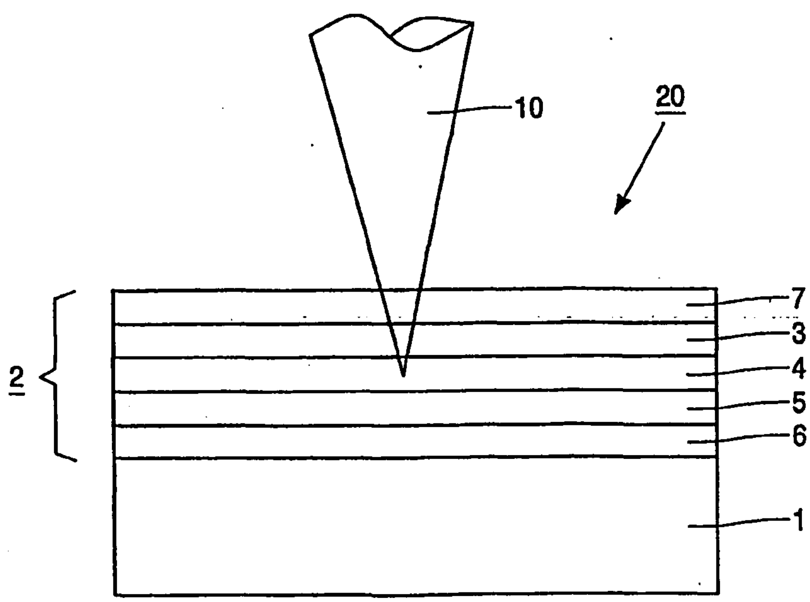
10
20
7
3
4
5
6
1
2

FIG. 2